ELK SIGHTABILITY MODEL DEVELOPMENT IN THE PACKWOOD AREA OF WEST CENTRAL WASHINGTON THE PUYALLUP TRIBE OF INDIANS 28 APRIL 2004

PREPARED BY:

Gilbert Environmental

UNDER THE DIRECTION AND PARTICIPATION OF:

Biological Staff
Puyallup Tribe of Indians
1850 Alexander Ave.
Tacoma, WA 98421
253-573-7993

1.0. Introduction

In Washington, elk population sizes are estimated by reconstruction with harvest data, mark-recapture, aerial sightability, and minimum count estimators (Bender and Spencer 1999). However, sightability models appear to be extremely rare for elk in western Washington, with no published models in common wildlife journals. The dense vegetation inhabited by elk in coastal and Cascade Mountain forests likely contributes to this by reducing sightability of elk. In addition, sightability modeling entails considerable logistic difficulty in establishing conditions that allow for the development of sightability models. This report summarizes an effort initiated by the Puyallup Tribe of Indians to develop a sightability model for elk in the South Rainier/Westside White Pass area ("Packwood area") of the Cascade Mountains in west central Washington state. The objective of the model development was to be better able to accurately estimate population size of the South Rainier elk herd. In pursuit of that objective, this report also includes recommendations for methodologies for future population assessment efforts in the South Rainier area.

2.0. Data Collection

2.1. Unit Development

Aerial surveys must be conducted in readily identifiable, exhaustive, non-overlapping units, throughout the area where the population occurs, to effectively estimate population size (Steinhorst and Samuel 1989). Therefore, the first step in this effort was to develop survey units. Survey units were designed to be from 3-6 mi^2 in area, taking approximately 1 hour to survey. Survey units were delineated using topologic breaks (ridges, rivers, major creeks, etc.) which would be easily identified by observers during surveys. For this effort, which focused on development of the sightability model, surveys were only conducted in areas where telemetered elk were likely to occur. Therefore, in order to develop an accurate total elk population estimate for the Packwood area, further effort will be required to develop survey units throughout the ultimate survey area (i.e. area where elk are known or likely to occur during late winter/early spring in the Packwood area).

A total of 12 units were delineated in the area thought to be occupied by telemetered elk. These units occurred on the north and south side of the Cowlitz river and generally spanned the river valley up to the hydrologic break of the river valley. These units represented the area of highest likelihood of finding elk during late winter in the Packwood area. Areas of lower likelihood were not included in this effort and would need to be surveyed to effectively estimate population size for the elk population in this area.

2.2. Aerial Surveys

Surveys were conducted in a 206 B3 (Jet Ranger) helicopter with a pilot and three observers. Average survey speed was approximately 60 mph. Survey units were randomly selected and surveyed systematically to ensure total coverage. When an elk was detected by an observer, the pilot stopped the search and focused on the area where elk were sighted. Group size and composition were recorded, with particular emphasis on differentiation of calves from cows. Elk were classified into the following groups: cows, calves, spike bulls, raghorn (bulls generally without brow tines and/or less than full antler development), adult bulls, and unclassifiable. Data for each group sighted were recorded including: activity when sighted (categorical variable including bedded, standing, or moving based on the most active elk in the group when first sighted), percent vegetation cover (expressed as a percent between 0 and 100), vegetation class (categorical variable including conifer, hardwood, or mixed), and percent snow cover. Percent vegetation cover was determined by estimating the percentage of the group obstructed by vegetation in an area including all elk in a group with an additional 30' buffer margin.

During surveys, all groups were checked for radio signals from radio collar transmitters. If a group contained a collared animal, that animal's frequency was removed from the list of available frequencies. Once the survey of a unit was completed, the unit was reflown in an attempt to relocate the remaining animals on the frequency list. If an animal was relocated within the boundary of the recently flown unit, data were recorded as described above for sighted groups and that group was recorded as a "missed" group.

A total of 6 units (4 unique units, 2 units were repeated in subsequent surveys) were surveyed during 3 surveys in late February. All surveys were conducted in similar weather conditions (mostly cloudy, light winds, temperature in the 40's, no precipitation). A total of 386 elk in 46 groups were sighted during surveys while 55 elk in 16 groups were "missed" during surveys and located using telemetry gear.

3.0. Data Analysis/Model Development

Surveys conducted as described above resulted in the detection of "sighted" and "missed" elk groups. These binomial data were used in a logistic regression to estimate the probability that a group would be sighted. The variables considered in the logistic regression were group size, vegetation cover, vegetation class, and activity. Snow cover was not considered in the model since all surveys were conducted with virtually no snow on the ground. Logistic regressions were run for each of the 15 potential models. The best model, as determined by Akaike Information Criteria (Burnham and Anderson 1998), included group size, vegetation cover, and vegetation class (Table 1). Vegetation

cover and vegetation class appeared to be the most predictive variables, included in 4 of the top 5 models.

Regression coefficients and variable covariances from the "best" model (including group size, vegetation cover, and vegetation class variables) were used to develop the model description file (jrng_elk.MDF) used in Program Aerial Survey (Unsworth et al. 1999). This model was labeled "Elk, Jet Ranger, S. Rainier" within Program Aerial Survey. A survey specification file (jrng_elk.SSF) was also developed to provide survey specific information to Program Aerial Survey. In order to run this model in Program Aerial Survey, the MDF and SSF files must be copied to the Aerial Survey directory and then loaded as a potential model in the program.

Table 1. Summary of model selection results for logistic regression Models of elk sightability in the Packwood area.

Model	AIC value
group size, vegetation cover, vegetation class	46.892
vegetation cover, vegetation class	47.082
group size, vegetation cover, vegetation class, activity	47.950
group size, vegetation cover	48.063
vegetation cover, vegetation class, activity	48.507
vegetation cover	48.633
group size, vegetation cover, activity	49.743
vegetation cover, activity	50.498
group size, vegetation class	68.075
Group size	68.844
group size, vegetation class, activity	70.071
group size, activity	70.844
vegetation class	71.736
vegetation class, activity	73.618
Activity	74.706

4.0. Population Estimates

The purpose of this effort was to develop a sightability model for elk in the Packwood area and not to estimate population size. This was evident in how the survey was conducted. Survey units were developed and surveyed only in areas where radio collared elk were likely to occur. Although the areas surveyed coincided with the area most heavily used by elk in late winter in the Packwood area, areas out of the Cowlitz river valley were not surveyed. Therefore, any estimate of elk abundance using only Cowlitz river valley units may not accurately estimate population size for the entire elk population. However, as a test of the model files, estimates of population size were developed using the sighted groups during the surveys. The area included in the survey for estimation included 12 units and covered the Cowlitz river valley from High Valley (confluence of the Cowlitz and Lake Creek) to the confluence of the Cowlitz and Hopkins Creek (approximately 2 miles west of the highway bridge crossing the Cowlitz). Two separate estimates were developed, one using the first and second surveys (February 21st and 23rd) and one using the second and third surveys (February 23rd and 24th). All

three surveys could not be used for a single estimate because units in the first and third survey were repeated, which is incompatible with the data structure of Program Aerial Survey.

Estimates of population size and structure are presented in Table 2. Comparable estimates for Game Management Unit (GMU) 516 (Packwood) for 2003 or 2004 were not readily available, however these estimates would be approximately half of the estimated population size for the South Rainier herd (which includes GMUs 510 (Storm King) and 513 (South Rainier) (WDFW 2000)) in 1999. Estimates of herd composition from the aerial surveys were very similar (low bulls:100 cows, high calves:100 cows) to estimates for the South Rainier herd from 1996-1999 (WDFW 2000).

Table 2. Summary of aerial survey results for the Packwood area during late winter of 2004. Estimates should be viewed with caution since they are based on an incomplete survey of the area encompassing the elk herd in this area and were biased towards areas where radio collared elk were located.

	Feb 21-23 survey		Feb 23-24 survey		Average both surveys	
	estimate	90% CI bound	estimate	90% CI bound	estimate	90% CI bound
Total elk	688	410	947	349	818	380
cows	499	288	676	273	588	281
bulls	39	18	63	21	51	20
branched antler bulls	12	9	30	31	21	20
calves	150	109	207	92	179	101
spikes	27	14	33	10	30	12
raghorns	9	8	15	15	12	12
adult bulls	3	4	15	15	9	10
bulls:100 cows	8	6	9	5	9	6
calves:100 cows	30	26	31	17	31	22
spikes:100 bulls	69	45	52	25	61	35
raghorns:100 bulls	23	22	24	25	24	24
adult bulls:100 bulls	8	11	24	25	16	18
branched antler bulls:100 bulls	31	27	48	49	40	38

5.0. Survey Design Recommendations

The current survey unit delineations do not include the entire range of the population in the Packwood area. Although this information may be available from Washington Department of Fish and Wildlife, a delineated winter range would facilitate the completion of survey unit development. The current units cover the Cowlitz valley area, where most elk are thought to winter, but units adjacent to these valley units would likely need to be surveyed to determine elk distribution and, assuming elk are found in these units, to accurately estimate the elk population. If elk are found in these units, it is likely that they would be at lower density than found in the valley units. Therefore a stratified sampling approach would be most appropriate, with valley units considered "high" density units and adjacent units considered "low" density units. Units could then be randomly selected from each stratum. The number of units sampled in each stratum

would depend on the funds available for surveys. Sample size calculations could be used to ensure adequate confidence in population estimates, especially as used to compare significance in changes in estimates over time. .Program Aerial Survey is designed for use in stratified sampling efforts as described above and so such data would be handled easily in the existing program. Further, the "Allocate" procedure in Program Aerial Survey provides an aid to drawing proportional samples for survey strata and provides estimates of sample size given a user-specified error bound. In general, surveys should consist of at least 5 units per stratum (Unsworth et al. 1999).

As described above, survey unit boundaries should be delineated so that they are easily identifiable to surveyors and stable over long periods of time. Reliance on temporal features such as forest cover types should be avoided while topographic figures should be used whenever possible.

Special attention should be paid to sex differences in late winter distribution. Surveys in the valley units did show a small number of bulls and estimated ratios from Aerial Survey output indicated ratios comparable to past population estimates. However, if males, especially adult males, are more common in units adjacent to the valley rather than in the valley, then surveys should take this into consideration and effort should be specifically designated towards accurately estimating bull abundance.

Future surveys could also be used to collect additional sightability data. Units with radio-collared elk could be surveyed in the framework of a stratified random sample. After completion of the survey, units could be searched for any elk groups that may have been "missed" by the use of telemetry gear. Further sightability surveys could enhance the model used to estimate abundance. Inclusion of elk activity into the model could result from futher surveys as more samples are collected. The current data set was heavily dominated by groups with the activity of "standing" and hence activity did not come out as a significant contributor to estimating sightability.

6.0. Summary

Sightability modeling applied to the elk population in the Packwood area appears to have demonstrated promising results. Delineated units appeared to be reasonably effective for aerial surveys. Survey time per subunit was approximately 1:12 minutes, including time for relocating telemetered elk, suggesting that units were the proper unit size for aerial surveys units (Unsworth et al. 1999). The best model for elk sightability included group size, vegetation cover, and vegetation class. The elk population estimate for the Packwood valley area ranged from 688 to 947 elk and averaged 818 for the two survey combinations.

New survey units will need to be developed to completely cover the area of elk distribution for the Packwood area. A stratified random sampling procedure will be developed, with valley units designated as "high density" areas and units adjacent to the Cowlitz valley as "low density" areas. Program Aerial Survey provides the software

platform for estimating population size from survey data. A model for the Packwood area was developed and added to Program Aerial Survey.

The Puyallup Tribe plans to complete the next phase of the project as described above during years 2005-2006. Comparative analysis of the current population model being utilized (Population Reconstruction) and the new sightability model will be conducted. Results of the analysis will be available through the Puyallup Tribal Wildlife Department. Positive results of the model development will enable the Tribes and State Wildlife Managers to better estimate population size and structure and manage the South Rainier Elk Herd. The sightability model findings may be used as a template for model development for other Western Washington elk herds.

7.0. Literature Cited

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